

OLLSCOIL NA hÉIREANN GAILLIMH
NATIONAL UNIVERSITY OF IRELAND GALWAY

SEMESTER II
SUMMER EXAMINATIONS 2000

Second University Examination in Computer Science

Computer Science (CS205)

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Time allowed: **Three hours**
Answer only five questions

1. (a) What is an Operating System, and how does it function - in your answer discuss the importance of the Interrupt concept, Kernel/User modes and heirarchies.
(b) Two of the most popular operating systems currently are Unix and NT - compare and contrast the two systems.
2. (a) How is a process 'created' in the Unix O.S.? Describe the subsequent life-cycle of that process. What is the difference between a process and a thread - what advantages are there to the latter?
(b) What is the difference between the preemptive & non-preemptive scheduling of processes - give examples of the various scheduling algorithms which implement these strategies. Which types would discriminate against short processes?
3. (a) Explain how concurrent processing may lead to the potentially hazardous race condition scenario.
(b) What is a semaphore, and how does one implement them? Illustrate your answer with the example of two process synchronisation.
(c) What four requisites together guarantee Deadlock? Discuss the principle methods to prevent Deadlock.
4. Write short notes on the following using examples where appropriate
 - (a) Distributed Systems

- (b) Paging & Segmentation
- (c) Thrashing
- (d) Operating System stability

5. Consider the polynomial $(1+x)^n$. Write a MAPLE procedure to evaluate the expansion of this function up to x^m .

6. (a) Algorithm A below is supposed to compute the quotient q and remainder r when m is divided by n , where m and n are positive integers. Run the algorithm with $m = 21$ and $n = 6$ and find a loop invariant. Hence, or otherwise, prove that the algorithm is correct.
- (b) Show that the statement "7 divides x " is a loop invariant for Algorithm B below. Find the values of $n \geq 1$ for which the algorithm terminates.

A

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x ← m; y ← n; z ← 0
while x ≥ y do
    x ← x - y
    z ← z + 1
q ← z
r ← x
    
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B

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x ← n
while x > 3 do
    if x even
    then x ←  $\frac{x}{2}$ 
    else x ← x + 7
m ← x
    
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7. (a) Describe the sorting algorithms

(i) Merge Sort (ii) Tree Sort

and use each of them to arrange the letters

A L G O R I T H M

in alphabetical order.

- (b) Explain what is meant by the term complexity for a comparison-based algorithm. Show that Merge Sort has complexity $O(n \log n)$.
- (c) EITHER show that every comparison based sorting algorithm has complexity of at least $O(n \log n)$
OR show that Tree Sort has average complexity $O(n \log n)$.